



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2018 PROJECT SUMMARY

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<b>Project Title</b> Replacing Plastics: Innovating Biodegradable Bio-based Films, Part II	
<b>Abstract</b> <b>Objectives/Goals</b> The objective of this engineering project was to increase the water resistance to less than 35% mass loss and test the biodegradability of the protein-based films created in last year's project. <b>Methods/Materials</b> The base films were formed from distilled water, 80% casein protein concentrate, and glycerol, and were dried for 48 hours on a Teflon-coated pan. To improve water resistance, three measurements (.05 grams, .1 grams, .15 grams) of pectin or ferulic acid were added into the base solution and compared against each other. These water-resistant films were weighed before and after being submerged in water to test mass change. To test biodegradability, the base films and the ferulic acid films (the best performing films) were planted in bean, marigold, and cilantro pots and given 14 days to grow and biodegrade. <b>Results</b> The experimentation finds that 0.05 grams of ferulic acid added to the base casein solution performed best in water resistance, losing on 28.4% of the initial mass as compared to the 75.9% mass loss the normal casein films had. All films were able to fully biodegrade within 14 days of plantation. Bean plant growth increased 397% and 433% with the ferulic acid films and the base casein films respectively. Marigold growth was shortened to 69% and 35% of control plant size by the casein and ferulic acid films. Cilantro plant growth was shortened to 73% of original plant size for the casein films, but grew 118% of its original size for the ferulic acid films. <b>Conclusions/Discussion</b> The water solubility of normal casein films is decreased by 47.5% with the addition of 0.05 grams of ferulic acid. The films do not stunt plant growth. Instead, they decrease height in flowering plants, and tremendously increase growth in bean and cilantro plants.	
<b>Summary Statement</b> We created biodegradable, protein-based films, improved their water resistance, and tested their biodegradability and effects on environment.	
<b>Help Received</b> No help was received. All research, experimentation, and analysis was student conducted.	